CONTRIBUTIONS TO THE GENUS *PARADILEPIS* HSÜ, 1935

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(With 16 Figures in the Text)

INTRODUCTION

The genus *Paradilepis* Hsü, 1935 syn. *Meggittiella* Lopez-Neyra, 1942, is defined as follows (Hsü, 1935, p. 536): 'Dilepididae. Rostellum armed with a double crown of hooks. External segmentation little marked. Genital pores unilateral. Genital ducts pass dorsal to excretory vessels and to nerve. Testes few in number, situated to either side of the female glands. Uterus sacciform, little lobed. Parasites of birds.'

Hsü gives *P. duboisi* Hsü, 1935, as the type species of the genus: Joyeux & Baer (1935) propose that *P. duboisi* become a synonym of *P. scolecina* (Rud. 1819) Joyeux & Baer, 1935; thus *P. scolecina* becomes the type species.

The majority of the members of the genus *Paradilepis* are parasites of Pelecaniform birds, virtually confined to the cormorants. Species have been reported from birds from Africa, Europe, Australia, the Far East and from North America.

The normal techniques were employed in microscopical preparations. For the hooks, the distance from the tip of the blade to the tip of the handle is considered as the length, and that from the tip of the handle to the tip of the guard as the base. All host names cited in the text have been revised according to Peters's *Check-list of Birds of the World*, vol. I, Harvard University Press, 1931.

The species so far reported for this genus are: *P. scolecina* (Rud. 1819) Joyeux & Baer, 1935; *P. delachauxi* (Fuhrm. 1909) Joyeux & Baer, 1935; *P. kempi* (Southwell, 1921) Joyeux & Baer, 1950; *P. macracantha* Joyeux & Baer, 1935; *P. simoni* Rausch, 1949; *P. urceus* (Wedl, 1855) Joyeux & Baer, 1950.

Paradilepis scolecina (Rud., 1819), Hsü, 1935 (Figs. 1–3)

syn. *Taenia scolecina* Rud. 1819.
T. scolecina Rud., 1819 *nec* Joyeux & Baer, 1928.
Paradilepis duboisi Hsü, 1935.
P. brevis Burt, 1940.
Dilepis minima Goss, 1940.

No fresh specimens of this species were available, but prepared material from various sources was examined, and comparative measurements were made in order to gain some idea of individual variation. This material, all from *Phalacrocorax carbo* L., included the type material from Northern Europe, preparations made by Krabbe from Prussia, specimens collected by Baer from Lake Geneva, material from Roumania and preparations from the Berlin and Vienna Museums,

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collected in Europe; and lastly Hsü's type material of *Paradilepis duboisi* from *Phalacrocorax capillatus* (Temm. & Schleg.) from Peiping. The measurements obtained are given in Tables 1 and 2 below.

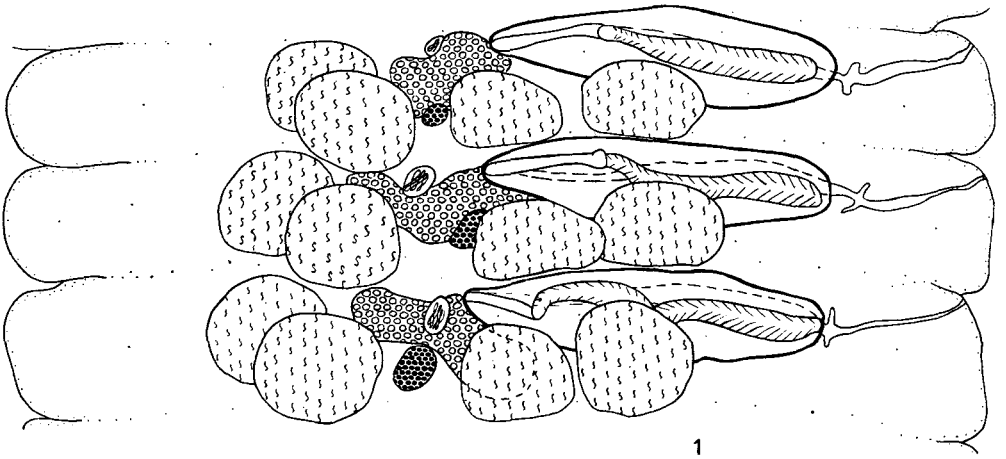

Fig. 1. *Paradilepis scolecina* (Rud. 1819) from *Phalacrocorax varius* (Gm.): dorsal view of whole mount of mature segment.

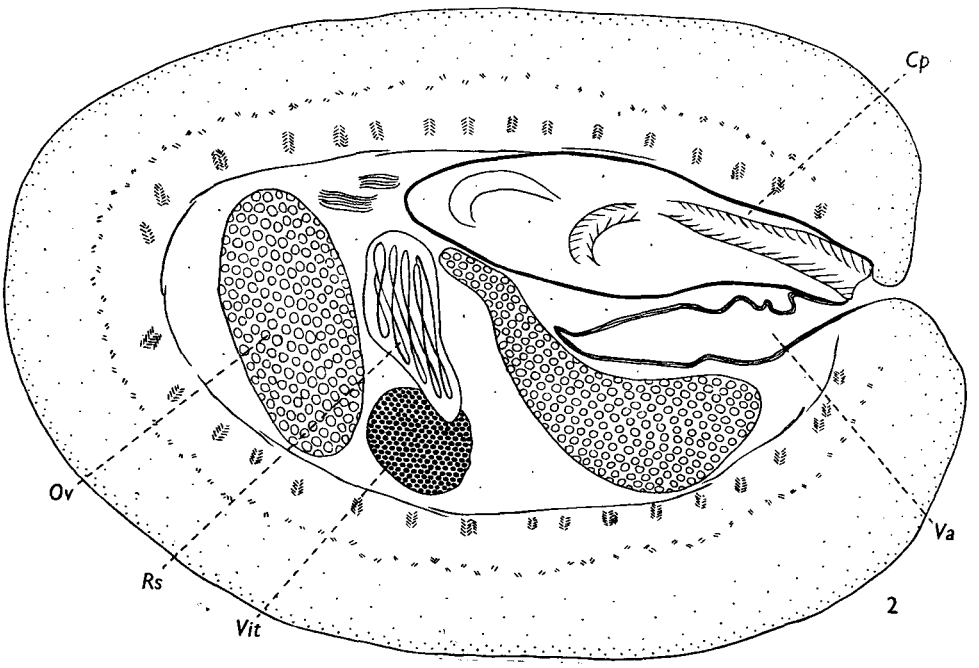

Fig. 2. *Paradilepis scolecina* (Rud. 1819) from *Phalacrocorax varius* (Gm.): tranverse section of mature segment *Cp*, cirrus pouch; *Ov*, ovary; *Rs*, seminal reservoir; *Va*, vagina; *Vit*, vitelline gland.

Rudolphi (1819) describes this species for the first time from *Phalacrocorax carbo* L. from Northern Europe, under the name of *Taenia scolecina*. Joyeux & Baer (1935) transfer *T. scolecina* to the genus *Paradilepis* (as does Hsü, 1935),

and consider *P. duboisi* to be identical with *P. scolecina*: thus *P. scolecina* becomes the type species of the genus. In a later paper, Joyeux & Baer (1950) consider *P. brevis* Burt, 1940 from *Phalacrocorax fuscicollis* Stephens, from Ceylon, to be a synonym of *Paradilepis scolecina*. The measurements given by Hsü (1935) for his *P. duboisi* and by Burt (1940) for his *P. brevis* are given in Table 2.

Goss (1940) describes a worm from Australian shags, *Phalacrocorax varius* (Gm.), *P. ater*,* *P. carbo* L. and *Haliëtor melanoleucus* (Vieill) from West Australia, and calls it *Dilepis minima*. On the examination of the co-type material received from Australia, this species is seen to be identical with *Paradilepis scolecina* (Figs. 1–3), the measurements falling well within the limits for the latter species, as may be seen from Tables 1 and 2. We propose, therefore, that *Dilepis minima* Goss, 1940 become a synonym of *Paradilepis scolecina* (Rud. 1819).

The hosts and localities from which this species has been reported are:

Host	Locality
Phalacrocorax carbo L.	Europe (Rudolphi, 1819; Joyeux & Baer, 1930)
P. carbo hanedae Kuroda	Japan (Yamaguti, 1940)
P. capillatus (Temm. & Schleg.)	China (Hsü, 1935)
P. fuscicollis Stephens	Ceylon (Burt, 1940)
P. carbo L., *P. varius* (Gm.) and *Haliëtor melanoleucus* (Vieill.)	Australia (Goss, 1940)
Haliëtor africanus (Gm.)	Africa (Joyeux & Baer, 1928, 1930)

Yamaguti (1940) obtained a single, encysted cysticercoid larva from the body cavity of *Gnathopogon elongatus caerulescens* (Sauvage) which he ascribed to the species *Paradilepis scolecina*. He gives the number of hooks as twenty, arranged in a double crown. The large hooks have a length of 105 μ and the small ones a length of 75–78 μ. The larva was found in Japan in the same locality as that in which the adults were collected.

Paradilepis delachauxi (Fuhrmann, 1909) Joyeux & Baer, 1935 (Figs. 4–6)

syn. *Oligorchis delachauxi* Fuhrmann, 1909.
Dilepis scolecina Joyeux & Baer, 1928 *nec* Rudolphi, 1819.
D. lepidocolpos Burt, 1936.

The material on which the following description is based was collected in the Belgian Congo from the cormorant *Haliëtor africanus africanus* (Gm.).

The head of the worm is completely embedded in the host's gut wall. The scolex penetrates the mucosa and submucosa, and becomes enclosed in a sac formed by the proliferation of the serous layer. The cavity of this sac is lined with a layer of acellular material, probably necrotic.

The worm measures 65–85 mm. in length; its maximum width is 2 mm. at a point about two-thirds along the total length of the worm.

* Peters (1931, vol. I, footnote, p. 90) remarks that *Carbo ater* is based on a young bird of the species *Phalacrocorax magellanicus* (Gm.) probably taken on the Falkland Islands, and that the type locality for the former 'Shark Bay, West Australia' is erroneous. It therefore seems improbable that this bird was found in Australia.

Table 1. Paradilepis scolecina (*Rudolphi*, 1819) *Joyeux & Baer*, 1935

Measurements taken from...	Krabbe, 1869	Baer, 1935 measurements Krabbe's material	Personal measurements Krabbe's material	Baer, 1935	Personal measurements Baer's material	Personal measurements of material Berlin	Vienna	Roumania
Described as...	*T. scolecina*	—	—	*P. scolecina*	—	—	—	—
Length (mm.)	7	—	7	4–7	4	3	3	6
Breadth (mm.)	0·3	—	0·37	0·22	0·33	0·23	0·18	0·32
Scolex (μ)	—	—	320, 387	230–300	238–298	223–335	170–286	285–375
Rostellum (μ)	—	—	164	140–170	149–164	134–164	88–126	134–164
Suckers (μ)	—	—	—	120–136	104–127	90–120	75–123	112–127
No. of hooks	20							
Length of large hook (μ)	93	108–115	112–115	108–117	106–113	112–129	*c.* 102	105–113
Length of small hook (μ)	64	71–85	86–89	71–85	74–79	78–92	*c.* 82	78–82
Cirrus pouch (μ)	—	—	—	92–115	102–116	78–105	62–72	94–108
Eggs (μ)	—	—	—	18–23	17–19	19–22	17–22	12–15
Testes	—	—	—	4	4	—	—	—
Host		*P. carbo* L.			*P. carbo* L.		*P. carbo* L.	
Locality		Prussia			Lake Geneva		Europe	

The scolex has a diameter of 750 μ and is provided with four, nearly spherical suckers measuring 240–290 μ in diameter. The rostellum, diameter 390 μ, is armed with a double crown of hooks (Fig. 4), twenty-two in number. The large hooks

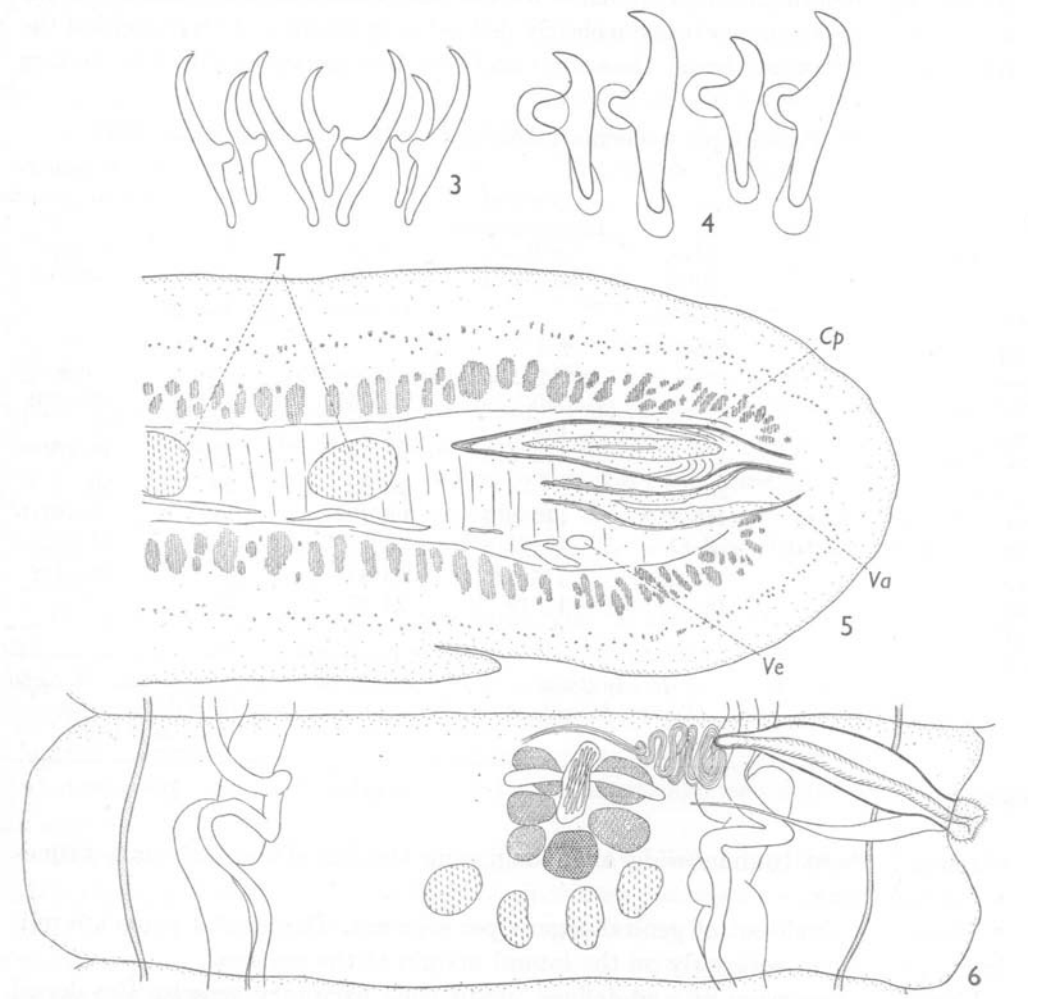

Fig. 3. *Paradilepis scolecina* (Rud. 1819) from *Phalacrocorax varius* (Gm.): rostellar hooks.

Fig. 4. *Paradilepis delachauxi* (Fuhrm. 1909) from *Haliëtor africanus africanus* (Gm.): rostellar hooks.

Fig. 5. *Paradilepis delachauxi* (Fuhrm. 1909) from *Haliëtor africanus africanus* (Gm.): transverse section of mature segment. *Cp*, cirrus pouch; *T*, testes; *Va*, vagina; *Ve*, ventral vessel.

Fig. 6. *Paradilepis delachauxi* (Fuhrm. 1909) from *Haliëtor africanus africanus* (Gm.): dorsal view of whole mount of mature segment.

measure 117–120 μ in length, and the small ones 88–91 μ. The guard and handle are provided with flattened, rounded appendages, which appear to be easily detached. The measurements given for the hooks include these disks. A comparison was made of the hook sizes of several specimens from *Phalacrocorax* sp. from Java. Two series of measurements were made, including and excluding these disks.

As may be seen from Table 3, there is a considerable individual variation in hook size.

The neck is short, and immediately behind the head, is of the same width as the scolex. On emerging into the lumen of the gut, the strobila rapidly attains a width of 1·3 mm. The segments become clearly defined only at about 10 mm. behind the head. They are much wider than long and the margins are entire. The mature

Table 2. Paradilepis scolecina (*Rudolphi*, 1819) *Joyeux & Baer*, 1935

Measurements taken from...	Hsü, 1935	Personal measurements of Hsü's material	Burt, 1940	Goss, 1940	Personal measurements of Goss' co-type material
Described as...	*P. duboisi*	—	*P. brevis*	*D. minima*	—
Length (mm.)	2·5–3·5	3	4	5·5	—
Breadth (mm.)	—	0·3	0·205–0·265	0·2	0·4
Scolex (μ)	350	350	255–340	310	296–360
Rostellum (μ)	174	149	92–102	140	96
Suckers (μ)	123	112–119	68–102	130	88–104
No. of hooks	20	—	20–22	20	20
Length of large hook (μ)	113–117	112–115	99–102	110	99–103
Length of small hook (μ)	79–81	79–81	64·6–72	100	73·5–76
Cirrus pouch (μ)	117–128	115–125	65–81	—	115–126
Eggs (μ)	18	17–19	24–27	14	—
Testes	4	4	4	—	4
Host	*P. capillatus* (Temm. & Schleg.)		*P. fuscicollis* Stephens	*P. varius* (Gm.) *P. carbo* L. *Haliëtor melanoleucos* (Vieill.)	
Locality	Peiping		Ceylon	Australia	

segment is about 10 times wider than long, while the gravid one is about 3–4 times wider than long.

There is a single set of genital organs per segment. The genital pores are unilateral, and open anteriorly on the lateral margin of the segment.

There are two pairs of well-defined, undulating excretory vessels. The dorsal canals, diameter 20–30 μ, are thick-walled. The ventral ones, 20 μ wide, are thin-walled and tend to lose their shape. The dorsal canals are wider than the ventral ones, the reverse of the usual condition. In each segment there is a single, transverse commissure, 10–14 μ in diameter.

The longitudinal musculature is composed of two bands of cortical muscles (Fig. 5). The outer, subcuticular layer consists of isolated fibres. The inner band is strongly developed and is composed of bundles of twenty to forty fibres. The medulla is clearly marked off from the cortex by a well-defined layer of transverse muscle fibres. The medulla occupies rather more than one-third of the total thickness of the segment, and is well supplied with isolated, dorso-ventral muscle fibres.

The male organs develop before the female glands, the testes being the first to

appear. The hindermost segments are almost completely filled with segmenting embryos.

The testes (Fig. 6) are four* in number, and variable in position. In certain segments one, and in others two testes are situated porally. At their maximum development, they extend almost to the dorsal and ventral limits of the medulla, and measure 110–128 μ by 85–102 μ. The vasa efferentia collect into the dorsal vas deferens, which is straight in the region of the testes, but which becomes highly convoluted as it passes porally, and enters the cirrus pouch without forming either external or internal seminal vesicles. The cirrus pouch is thick-walled and measures 272–298 μ in length and 77–93 μ at its maximum width. The cirrus is armed with numerous, backwardly directed, hooked spines, about 4·5 μ long.

The straight, thick-walled vagina opens from the genital atrium ventral to the cirrus pouch, and together with the vas deferens, passes dorsal to the excretory vessels. The vagina opens into a dorsal receptaculum seminis, a large sac-like organ filled with spermatozoa. The ovary is divided into five lobes and lies in the anterior part of the segment, posterior to the straight part of the vas deferens. The oviduct is gently coiled, and leads to the Mehlis's gland. The vitelline gland is compact, more or less spherical, and lies posterior to the ovary but somewhat in front of the testes. In the early stages of development, the ovarian and vitellarian tissues resemble each other closely, their histologies only becoming distinct in the functionally female segments.

The uterus is of the persistent, sacciform type. It appears as a small sac between the receptaculum seminis and the ovary. As it increases in size, it becomes very lobed, and filled with eggs. The uterus finally occupies the whole segment, extending laterally past the excretory canals. The lobes eventually disappear, leaving a single large sac with a continuous cavity. The ripest eggs found measure 27–34 μ in diameter. Each is provided with a granular envelope, and contains a segmenting embryo.

This species was first described by Fuhrmann (1909), from *Haliëtor africanus* (Gm.) from Egypt, but unfortunately his specimen possessed no scolex. Joyeux & Baer (1928) describe a contracted specimen from a cormorant from West Africa, possessing a head, and ascribe it to *Dilepis scolecina* (Rud., 1819). In 1935, Joyeux & Baer transfer their *D. scolecina* Joyeux & Baer, 1928 *nec* Rud. 1819 to the genus *Paradilepis* Hsü, 1935, the species in question becoming *P. delachauxi*.

Joyeux & Baer (1950) consider *Dilepis lepidocolpos* Burt, 1936 from *Haliëtor niger* (Vieill) from Ceylon, to be a synonym of *Paradilepis delachauxi*. The measurements given by Burt are shown in Table 3.

The hosts and localities so far recorded for this species are:

Host	Locality
Haliëtor africanus africanus (Gm.)	Africa (Fuhrmann, 1909; and present paper)
Haliëtor niger (Vieill.)	Ceylon (Burt, 1936)
Phalacrocorax sp.	Java (present paper)
Cormorant sp.	West Africa (Joyeux & Baer, 1928)

* Joyeux & Baer (1950) give five as the number of testes for *P. delachauxi*.

Table 3. Paradilepis delachauxi (*Fuhrmann*, 1909) *Joyeux & Baer*, 1935

Measurements taken from... Described as...	Personal *P. delachauxi*	Personal *P. delachauxi*	Fuhrmann, 1909 *O. delachauxi*	Burt, 1936 *D. lepidocolpos*
Length (mm.)	65–85	—	100	200
Breadth (mm.)	2	—	2	1·8
Scolex (μ)	750	915	500 Joyeux & Baer,	700
Rostellum (μ)	390	375	200 1928 de-	330
Suckers (μ)	240–290	300–375 × 225–300	170 scribed as	260
No. of hooks	22	20	20 *Dilepis sco-*	20
Large hook (μ)	117–120*	110–122 × 75–80* 96–110 × 59–66†	103 *lecina*	105
Small hook (μ)	88–91*	82–93 × 41–48* 68–82 × 28–37†	63	84
Cirrus pouch (μ)	272–298 × 77–93	298–335	300	¼ of breadth of segment i.e. *c.* 450
Testes	4	4	4	4 (rarely 2, 3, 5)
Eggs (μ)	27–34	Not ripe segs.	—	28
Diameter of dorsal excretory vessel	20–30	17–24	—	15
Diameter of ventral excretory vessel	20	40–50	—	60
Diameter of transverse excretory vessel	10–14	17–27	—	—
Host	*H. africanus africanus* (Gm.)	*Phalacrocorax* sp.	*H. africanus africanus* (Gm.)	*H. niger* (Vieill.)
Locality	Belgian Congo	Java	Egypt	Ceylon

* With appendages. † Without appendages.

Paradilepis kempi (Southwell, 1921) Joyeux & Baer, 1950 (Figs. 7–11)

syn. *Dilepis kempi* Southwell, 1921.
Hymenolepis kempi (Southwell, 1921) Mayhew, 1925.
Oligorchis burmanensis Johri, 1941.
Meggittiella kempi (Southwell, 1921) Lopez-Neyra, 1942.
Dilepis maxima Goss, 1940.

Fairly large numbers of this worm were present in the intestine of *Phalacrocorax* sp. from Java.

The worm measures 70–100 mm. in length. The neck region is very short and narrow, 0·26 mm. in width, and behind it the strobila gradually widens to a maximum width of 1·05 mm. at the terminal segments.

The scolex is almost spherical and has a diameter of 370 μ with the rostellum extruded (Fig. 8*a*), and 410 μ with the rostellum retracted (Fig. 8*b*). The scolex is provided with four ovoid suckers measuring 180–200 μ by 130–160 μ. The

rostellum, diameter 180–200 μ, is frequently seen everted, and is armed with twenty-eight hooks (Fig. 7) arranged in a double crown. The hooks are provided with very transparent, flattened appendages, easily overlooked in a cursory examination. Two series of measurements were made. The large hooks measure

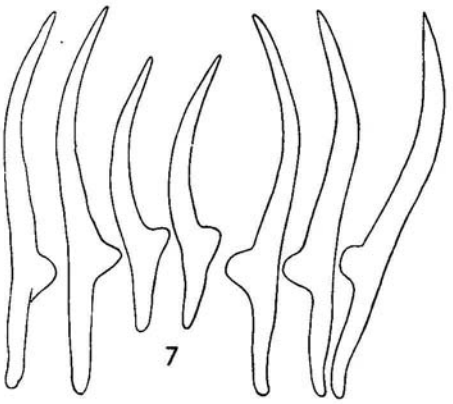

Fig. 7. *Paradilepis kempi* (Southwell, 1921) from *Phalacrocorax* sp.: rostellar hooks.

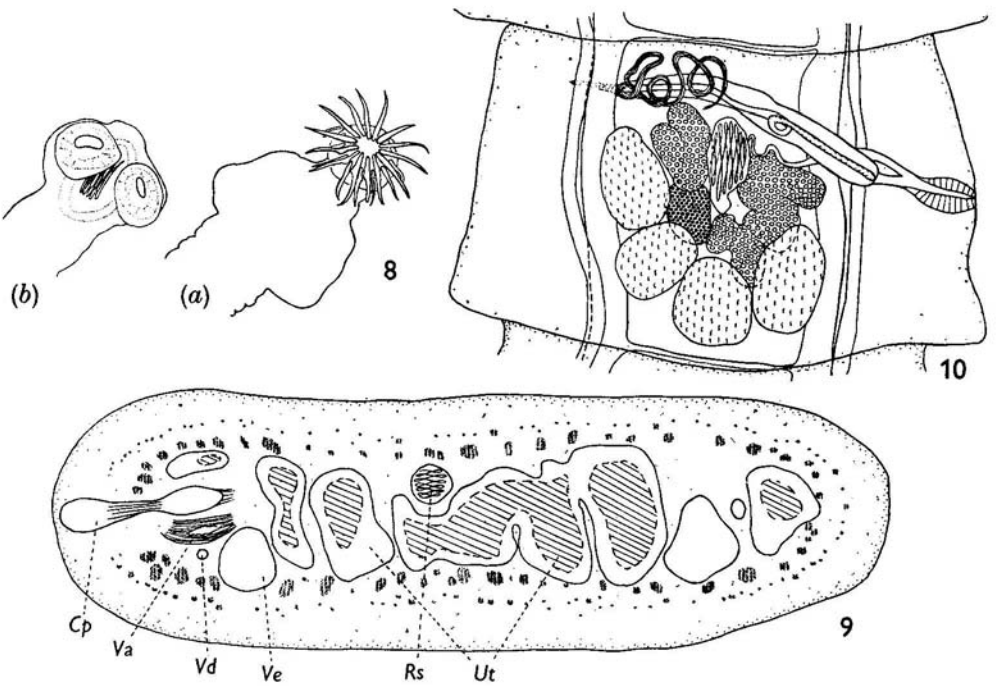

Fig. 8. *Paradilepis kempi* (Southwell, 1921) from *Phalacrocorax* sp.: scolex. (*a*) rostellum evaginated, (*b*) rostellum withdrawn.

Fig. 9. *Paradilepis kempi* (Southwell, 1921) from *Phalacrocorax* sp.: transverse section of mature segment. *Cp*, cirrus pouch; *Rs*, seminal reservoir; *Ut*, uterus; *Va*, vagina; *Vd*, dorsal vessel; *Ve*, ventral vessel.

Fig. 10. *Paradilepis kempi* (Southwell, 1921) from *Phalacrocorax* sp.: dorsal view of whole mount of mature segment.

180–190 μ including the appendages, and 173–187 μ excluding them. The small hooks have lengths of 126–133 μ and 122–126 μ respectively.

The majority of the segments are wider than long; the margins are entire. As the segments mature, they become relatively longer, and the width of the ripe segment is about three-quarters of its length.

There is one set of genital organs per segment. The genital pores are unilateral, and open in the middle of the lateral border of the segment.

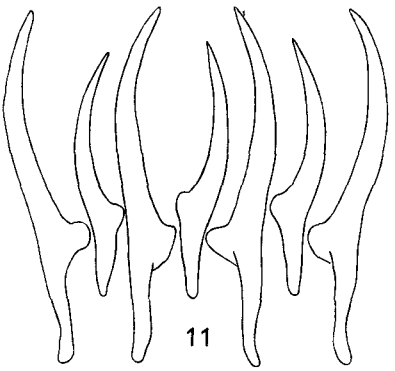

Fig. 11. *Paradilepis kempi* (Southwell, 1921) from *Haliëtor melanoleucos* (Vieill.): rostellar hooks.

The excretory system is of the normal type. There are two pairs of longitudinal canals, one dorsal and one ventral. The dorsal vessels are thick-walled, with a narrow lumen of diameter 17 μ. The ventral vessels are thin-walled and wider, of maximum diameter 50 μ. In each segment, the ventral vessels are connected by a transverse commissure, of diameter 24 μ.

The longitudinal musculature consists of two, well-defined layers of cortical muscles (Fig. 9). The outer layer is subcuticular and the fibres are grouped in bundles of four. The inner layer is strongly developed and is composed of about forty bundles each containing about twenty fibres. The circular muscles form a clearly defined, narrow band, marking off the medulla from the cortex. The medulla is provided with a limited number of dorso-ventral fibres.

There are four testes* (Fig. 10), oval in shape, and measuring 61–75 μ by 51–61 μ as seen in longitudinal section. In transverse section, the testes are seen to be dorsal in position. Their arrangement varies somewhat from segment to segment, usually one being poral and three aporal; alternatively, two are poral and two aporal. The three testes nearest the genital pore are situated in the same plane posterior to the female organs, while the fourth and most aporal is placed more anteriorly. The vas deferens is highly convoluted and leads into the cirrus pouch without forming either internal or external seminal vesicles. The cirrus pouch, measuring 223–260 μ in mature segments, and 260–298 μ in gravid ones, passes dorsally to the excretory vessels and extends along the anterior border of the

* In their key to the species of *Paradilepis*, Joyeux & Baer (1950) give three as the number of testes for *P. kempi* (*fide* Southwell).

segment almost to the aporal excretory canals. It empties into a well-developed, muscular, genital atrium.

The muscular vagina opens from the genital atrium ventral to the cirrus pouch, and passes dorsal to the excretory vessels. It leads into a well-developed receptaculum seminis. The ovary is bilobed, each lobe being sub-divided into two, three or four lobes. The yolk gland is compact and smaller than the ovarian lobes, between which it is situated in a posterior, ventral position.

The uterus appears as a simple sac, which later becomes lobed and filled with eggs, and gradually increases in size. Ultimately, the uterus fills the whole segment, extending into the cortex. The lobes disappear, and the uterus assumes the appearance of a large sac with a continuous cavity. The eggs contain an ovoid embryo, hookless, and measuring 24 by 14 μ. The shells vary considerably in shape, and appear to be deformed, but an average measurement is 35 by 25 μ.

Paradilepis kempi was first described as *Dilepis kempi* from *Haliëtor pygmaeus* (Pall.)* from Assam, by Southwell in 1921. In 1925, Mayhew transferred the species to the genus *Hymenolepis* Weinland, 1858, and in 1942 Lopez-Neyra removed it to the genus *Meggittiella* Lopez-Neyra, 1942. In 1950, Joyeux & Baer show *Meggittiella* to be a synonym of *Paradilepis* Hsü, 1935, the species in question thus becoming *Paradilepis kempi*.

As may be seen from the above description, and from Table 4, there are a number of discrepancies with Southwell's (1921), account, such as the number and size of the hooks and the number of testes.

Joyeux & Baer (1950) give *Oligorchis burmanensis* Johri, 1941 from *Phalacrocorax javanicus* (Horsfield) from Burma as a synonym of *Paradilepis kempi*. As seen from the table, Johri's measurements fall well within the limits of those given for *P. kempi*.

Goss (1940) described two cestodes from a shag, *Haliëtor melanoleucos* (Vieill.) from Western Australia. One, which she describes as *Dilepis maxima*, corresponds with *Paradilepis kempi*, and on examination of the co-type material received from Australia (Fig. 11) (measurements given in Table 4) is seen, in fact, to be identical with *Paradilepis kempi*. We propose, therefore, that *Dilepis maxima* Goss, 1940 become a synonym of *Paradilepis kempi* (Southwell, 1921) Joyeux & Baer, 1950.

The hosts and localities from which this worm has so far been reported are:

Host	Localities
Haliëtor melanoleucos (Vieill.)	Australia (Goss, 1940)
Haliëtor pygmeus (Pall.)	Assam (Southwell, 1921)
Phalacrocorax javanicus (Horsfield)	Burma (Johri, 1941)
Phalacrocorax sp.	Java (present paper)

Paradilepis macracantha Joyeux & Baer, 1935 (Fig. 12)

syn. *Dilepis delachauxi* Joyeux & Baer, 1930 *nec* Fuhrmann, 1909.

Joyeux & Baer (1935) propose this name for a worm which they described as *Dilepis delachauxi* in 1930 from *Haliëtor africanus* (Gm) from the Niger Valley. The scolex of this species is not buried in the mucosa of the host gut wall.

* Peters (1931, vol. I) records this bird as occurring in Europe, the Middle East, Persia and Afghanistan.

Table 4. Paradilepis kempi (*Southwell*, 1921) *Joyeux & Baer*, 1950

Measurements taken from...	Personal	Southwell, 1921	Johri, 1941	Goss, 1940	Personal measurements of Goss' co-type material
Described as...	*P. kempi*	*D. kempi*	*O. burmanensis*	*D. maxima*	—
Length (mm.)	70–100	50	32–46	130	—
Breadth (mm.)	1·05	1	0·89	1·21	1·2
Scolex (μ)	370–410	400	375–400	350	480 (in glycerine)
Rostellum (μ)	180–200	160	106–120	—	160
Suckers (μ)	180–200 × 130–160	100	165–188	114	160
No. of hooks	22	20	22	20	26
Length of large hook (μ)	180–190* 173–187†	175	163–188	153	180–184
Length of small hook (μ)	126–133* 122–126†	135	109–133	108	122–126
Cirrus pouch (μ)	223–298	Small and insignificant	240–317 (–410)	300	280–320
Number of testes	4	3	—	4	4
Eggs	35 × 25	—	28–34	35 × 21	32
Host	*Phalacrocorax* sp.	*Haliëtor pygmeus* (Pall.)	*P. javanicus* (Horsfield)	*Haliëtor melanoleucos* (Vieill.)	—
Locality	Java	Assam	Burma	Australia	

* With appendages. † Without appendages.

The type material was examined. The hooks (Fig. 12) measure 425–478 μ in the length for the large ones, and 276–290 μ for the small ones, which corresponds with the dimensions given in the original description (465 by 255 μ for the large hooks and 282 by 155 μ for the small ones).

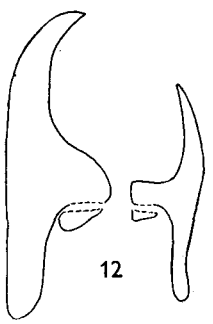

Fig. 12. *Paradilepis macracantha* Joyeux & Baer, 1935 from *H. africanus* (Gm.): rostellar hooks.

The anatomy of the strobila is similar to that of *P. delachauxi*.

This worm has not been reported since its discovery in 1930.

Paradilepis simoni Rausch, 1949

This species was described by Rausch (1949) from *Pandion haliaetus carolinensis* (Gm.) (Accipitriformes) from Wyoming, and is the first record of a species of the genus *Paradilepis* occurring in North America. It is the second worm (the other being *P. urceus* reported from Accipitriformes and Ciconiiformes) to be recorded from a bird which does not belong to the order Pelecaniformes. Rausch (1949, p. 3) remarks that, 'it is possible that *P. simoni* is an accidental parasite of the osprey and occurs naturally in

cormorants', but that 'at the present there is no reason to doubt that the osprey is the natural host of *P. simoni*'. However, Joyeux & Baer (1950, footnote, p. 94) say 'This is the second species to be reported from a fish-eating accipitrine and it appears more than likely, as suggested by Rausch, that the true host belongs either to the Pelecaniformes or to the Ardeiformes.' (Ardeiformes = Ciconiiformes *p.p.*).

For the sake of completeness, Rausch's measurements are given here. Length of worm, 50–90 mm., maximum breadth, 0·45 mm. Scolex diameter 470–596 μ and suckers diameter 180–220 μ. Rostellum 100 μ long and armed with thirty-six hooks arranged in a double crown. Large hooks 98–102 μ long and the small ones 68–72 μ long. Genital pores unilateral: testes five in number. Cirrus pouch measures 100–132 μ by 30–40 μ. Eggs diameter 27–33 μ and the embryonic hooks length 6 μ.

The only record is that in the original description.

Paradilepis urceus (Wedl, 1855) Joyeux & Baer, 1950 (Figs. 13 to 15)

syn. *Dilepis urceus* Wedl, 1855
Hymenolepis urceus (Wedl, 1855) Meggitt, 1927
H. multihamata Meggitt, 1927
Oligorchis hieraticos Johri, 1934
Meggittiella multihamata (Meggitt, 1927) Lopez-Neyra, 1942

No fresh material was available, but specimens from *Platalea leucorodia* L. (Ciconiiformes) from Looss' collection from Cairo were examined, and the measurements obtained may be seen in Table 5. Preparations from the Berlin and Vienna

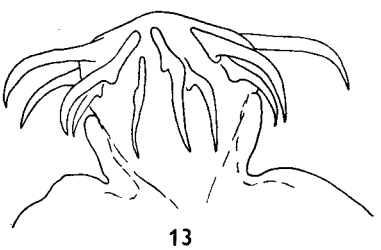

Fig. 13. *Paradilepis urceus* (Wedl, 1855) from *Platalea leucorodia* L.: scolex.

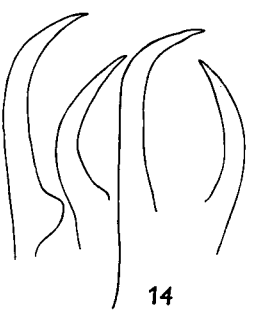

Fig. 14. *Paradilepis urceus* (Wedl, 1855) from *Platalea leucorodia* L.: rostellar hooks.

Museums were also examined, but these were found to be identical with *Paradilepis scolecina*. As may be seen from the table, the dimensions of the large hooks of *P. scolecina* and *P. urceus* (Fig. 13) fall within the same range (large hook 99–177 μ and small hook 65–85 μ for the former species; large hook 110–120 μ and small one 83–100 μ for the latter). The shapes are somewhat different, however, the tip of the hook of *P. urceus* (Fig. 14) being slightly more curved. The appearance of the entire worm is also different *P. urceus* having a short, stumpy form (Fig. 15) *P. urceus* has three to four testes, and *P. scolecina* has four.

Table 5. Paradilepis urceus (*Wedl*, 1855) *Joyeux & Baer*, 1950

Measurements taken from...	Wedl 1855	Krabbe, 1869	Personal measurements of Looss' material	Meggitt, 1927	Personal measurements of Meggitt's co-type material	Johri, 1934
Described as...	*T. urceus*	*T. urceus*	—	*H. multihamata*	—	*O. hieraticos*
Length (mm.)	4	4	2·5	2	—	6·5
Breadth (mm.)	0·33	0·3	0·37	0·3	—	0·45
Scolex (μ)	—	—	283	220–300	253	375–390
Rostellum (μ)	—	—	134	60	156	130
Suckers (μ)	—	—	112–120	—	112	110–140
No. of hooks	20	20	20	—	—	16–18
Length of large hook (μ)	110	110–111	122	115–120	—	113–190*
Length of small hook (μ)	—	73–76	89	83–95	—	83–100
Cirrus pouch (μ)	—	—	96–108	150–170 × 40	65 × 32 (mature segs. only)	65–125
Number of testes	—	—	—	3	3–4	4 (from drawing)
Eggs (μ)	48	—	23–26 × 18–19	—	—	—
Host	*Plegadis falcinella* (L.)	*Platalea* sp.	*P. leucorodia* L.	*M. migrans aegyptius* (Gm.)		*M. migrans govinda* Sykes
Locality	Austria	Europe	Egypt	Egypt		India

* Joyeux & Baer (1950 p. 93) say 'It is no doubt by mistake that Johri states the length of the large hooks as varying from 113 to 190 μ.'

This species was first described by Wedl (1855) as *Taenia urceus* from *Plegadis falcinellus* (L.) (Ciconiiformes) from Austria. Krabbe (1869) re-described the species, basing his description on specimens from *Platalea* sp.

Joyeux & Baer (1950) consider *Hymenolepis multihamata* Meggitt, 1927 from *Milvus migrans aegyptius* (Gm.) (Accipitriformes) from Egypt, to be a synonym of *P. urceus*. The co-type material of *Hymenolepis multihamata* was examined and the measurements, together with those taken from Meggitt (1927), are given in Table 5.

In the same paper Joyeux & Baer (*loc. cit.*) also make *Oligorchis hieraticos* Johri, 1934 from *Milvus migrans govinda* Sykes from India, a synonym of *Paradilepis urceus*. The dimensions given by Johri (1934) may also be seen in Table 5.

The hosts and localities reported for this worm are:

Hosts	Localities
Plegadis falcinella (L.)	Austria (Wedl, 1855)
Platalea leucorodia L.	Egypt (Joyeux & Baer, 1950) Europe (Krabbe, 1869)
Milvus migrans aegyptius (Gm.)	Egypt (Meggitt, 1927)
M. migrans govinda Sykes	India (Johri, 1934)

Larva: *Glossocercus cyprinodontis* Chandler, 1935 (Fig. 16)

Chandler (1935) describes a new species of larva found in the body cavity of *Cyprinodon variegatus* and *Fundulus heteroclitus* from Texas. The scolex bears twenty hooks arranged in a double crown. The large hooks measure 180 μ in length and the small ones 130 μ.

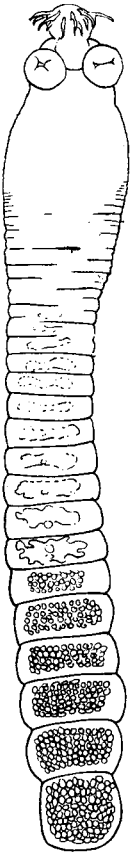

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Fig. 15. *Paradilepis urceus* (Wedl, 1855) from *Platalea leucorodia* L.: dorsal view of entire specimen.

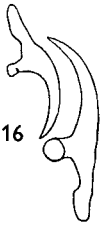

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Fig. 16. *Glossocercus cyprinodontis* Chandler, 1935 from *Cyprinodon variegatus*: rostellar hooks (after Chandler).

Chandler remarks that his specimen does not appear to fit any described larval species and approaches the larva most closely to *Dilepis kempi*. Chandler's drawing of the hooks (1935, p. X, fig. 5) is reproduced in Fig. 16.

I would like to thank Professor J. G. Baer, Director of the Institut de Zoologie, Université de Neuchâtel, for his helpful interest in the preparation of this paper.

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ADDENDUM

I have been unable to take into account a paper by R. S. FREEMAN entitled *Paradilepis rugovaginosus* n.sp. (Cestoda: Dilepididae) from the Osprey, with notes on the genus *Oligorchis* Fuhrmann, 1906 that appeared in the *Journal of Parasitology*, **40**, 22–8, 5 figs., while my own paper was in the press.